PRELIMINARY NOTES ON CERTAIN PHASES OF THE BEHAVIOR AND HABITS OF PROCERATIUM CROCEUM ROGER

By Caryl Parker Haskins

Because of the great kindness of Dr. M. R. Smith, of the State Plant Board of Mississippi, who repeatedly and generously supplied the writer with living queens and workers of the rare hypogeaic ant *Proceratium croceum* Roger (Ponerinæ, Proceratii) it has been possible to subject living colonies of the ant, housed in modified Lubbock nests, to daily observations for more than a year. While innumerable problems of behavior and of general biology remain to be solved, it has seemed to the writer that sufficient material has accumulated, considering the nature of the species, to warrant a preliminary presentation of it at this time, in the hope that it may be of some interest to those concerned with our American hypogeaic Ponerinæ.

Nesting Habits and the Formation of New Colonies

Such notes as are presented concerning the nesting sites and the characteristics of adult colonies of *Proceratium croceum* were generously placed at my disposal by Dr. Smith, and refer to the ant in Mississippi.

Like most of the hypogeaic Ponerines, *Proceratium croceum* habitually associates itself with glade or deep-woods ants, seeking the less severe competition of silvicolous areas. In forested or relatively wooded land the adult colonies are excavated in moist fallen timber by preference, the rambling galleries and poorly finished chambers giving no external evidence of their existence. The colonies are often rather small, ranging from a very few workers associated with an alate queen up to twenty or so, but in favorable situations the colonies may be much larger than this, as with others of the Proceratii and Amblyoponæ. It is probable that under natural conditions the workers are prac-

tically strictly hypogeaic, but individuals colonized in artificial nests exhibited such a marked tendency to emerge occasionally into the open air, thereafter returning underground, as to leave some suspicion that they may occasionally do this under natural conditions.

In Mississippi the adult colonies bring their winged forms to maturity in August, and these are produced occasionally in no inconsiderable numbers. Dr. Smith took from a single colony between twenty and thirty winged queens; this same community containing a number of males, hitherto undescribed. The young queens are completely pigmented before attempting the nuptial flight. They dealate themselves rather readily if the flight is artificially delayed. A group of six young queens sent to the writer while in the winged condition dealated themselves *en route* and thereafter behaved precisely like fertile females.

There is considerable evidence that young females of the species are quite capable of and accustomed to forming new colonies without assistance, in the fashion typical of higher ants. Young fertile queens artificially nested together in damp wood have repeatedly separated and built individual cells, which were finished and closed in the fashion typical of higher queens. Several of these young queens thus isolated in December have produced eggs the following March, which they attended carefully and hatched. They were artificially fed during the intervening period, but there was every evidence that the fat body, reinforced by the diminishing wing-muscles, alone would have sufficed to produce the eggs and probably to rear a few minute larvæ.

LENGTH OF DEVELOPMENTAL PERIOD, AND CARE OF THE LARVÆ

Notes taken on the developmental periods of the young are at present almost wholly incomplete, owing to the fact that no larvæ have as yet survived to maturity under artificial conditions. Three eggs laid by young fertile queens hatched in twenty, twenty, and twenty-one days respectively. *Proceratium* shows little tendency to devour ova, and this fact combined with the circumstances that the adults in laying colonies were kept con-

stantly full fed has, the writer believes, diminished the chance which is always present in the determination of the incubation period of ant ova, that the eggs which were observed to hatch were not those observed as laid, the original specimens having been devoured and others immediately deposited in their place. The incubation periods for infertile ova were substantially the same, three eggs laid by unfertilized queens hatching in twenty-one, twenty, and, curiously enough, eleven days respectively. It is probable that the abnormal recording was caused by some unchecked error of observation. The temperature of incubation was a mean of about 23° C.

Proceratium croceum pays much attention to the eggs, whether they be laid and tended by a single fertile female, or in a large colony. They are carefully licked and carried about, and usually agglutinated in small packets. The larvæ, when hatched, are left on the egg packet for three or four days, and during this period are not differentiated by the nurses from unhatched ova. The larvæ are short and thick set, with large heads, and are noticeably inactive. They show no tendency to devour unhatched eggs, and during the first week of life give no indication of hunger, nor are they, so far as could be observed, fed. When about a week old, the larvæ are removed from the unhatched eggs, and are then placed on whatever food may chance to have been brought into the brood chamber. Even at this stage they show none of the activity usual to Ponerine larvæ, but attach themselves to their victims and remain in this position for days, feeding extremely slowly. While feeding they are eagerly licked for exudates, and some indication has been seen of a tendency to pinch them to hasten the flow. When full-fed they drop from their victims, more after the fashion of the larvæ of solitary wasps than of ants, and are then allowed to lie singly on the chamber floor. Growth, under artificial conditions at least, is extremely slow. The larvæ have never been seen to move, their complete immobility reminding one strongly of the behavior of many Myrmicine larvæ, and contrasting strangely with their thoroughly entomophagous habits. No verifiable case has been seen by the writer in which any attempt was made by a nurse to feed the larvæ by regurgitation, although the mouth and the first

thoracic segments of the larvæ were often assiduously licked, perhaps to obtain a minute quantity of saliva present with the exudates.

When disturbed, the brood nurses eagerly seize both eggs and larvæ and hurry away with them. When undisturbed, however, they showed an increasing tendency to neglect the larvæ more and more as the latter grew older, and in every case the young when two or three months old were no longer placed on the insect material brought into the nest to be devoured by the adults. The young made no attempt to help themselves, but shriveled and soon perished, when they were either thrown away or devoured by the nurses.

Social Habits

The relations of the adults of *croceum* to one another, though primitive, are yet more complex than might at first appear. Foraging is done by single workers, and appears to be confined entirely underground. The ants are wholly entomophagous. Honey and sweet materials of all kinds are not recognized as edible. Larvæ of *Lasius americanus, Lasius umbratus, Camponotus americanus,* and *Stigmatomma pallipes* were eagerly accepted in the artificial nest. Cocoons of the first-named species were opened by a few individuals and the pupæ extracted, a fact possibly significant of relations between adults and pupæ about to be enclosed, although there seems little doubt that the latter may escape without assistance if required to. After repeated trials, meat was accepted as edible by a few individuals after marked hesitation.

Under artificial conditions, foraging individuals exhibit the curious habit, when prey is discovered, of reversing their position and backing up to it to insert their stings, instead of attempting to seize it with the mandibles. This behavior has been repeatedly observed, but whether it is practiced in the wild state can only be surmised, together with the means whereby the intended prey is induced to remain motionless during the lengthy procedure. The prey having been stung, it is dragged to the brood chamber by the mandibles in usual fashion, and there devoured and covered with the larvæ.

No indication of regurgitation has been seen between adults, although there is a clear foreshadowing of it in the habit frequently seen of licking the gula and interlocking divaricated mandibles while soliciting with the forefeet. The habit of deportation is strongly developed, although it is extremely generalized and undertaken without precision. The individual to be deported is seized by the mandibles, or by the posterior margins of the head, or by the petiole, or by the first or second gastric segments, and forcibly dragged. It is significant, however, that the individual deported frequently makes no attempt to escape, but submits quiescently to the treatment. It has never been seen employed in times of danger, but is to be noticed at most other times, especially when the ants are feeding on prey newly brought in. Dr. Smith has observed a much more elaborate and precise form of deportation, rather closely resembling the habit of Leptothorax, though undertaken apparently with no definite purpose in view. The ants concerned locked mandibles, and the deported individual bent the body, dorsal side up, over that of its porter.

Fertile females are given no special attention in the colony, and it does not seem possible to differentiate them from the worker personnel in point of activity or skill in nest duties. Some individuals, to be sure, are somewhat more sluggish than the workers, and this is perhaps more true of old females in established colonies, but many individuals are both more active and more skillful in carrying on nest activities than the bulk of their workers, and the major portion of labor may devolve upon them.

The integrity of colonies is well preserved, alien individuals being quickly detected and attacked. It is also significant that young queens, a few weeks after their flight, are no longer recognized by their own sisters or by the workers of their old colonies.

The brood-chambers are kept clean and free from foreign material, but little tendency has been seen to establish kitchen-middens. Foreign particles are sometimes buried in the chamber walls, but more often are carried afield and deposited in an unused gallery. Dead adult members of the colony are carefully taken to the point furthest removed from the living nest, and

left there. The usual reaction, apparently so universal among ants in general, of depositing earth upon moist spots in the nest, is present.

SENSES

Little can be said at the present time on this score, not because of lack of good evidence, but because of lack of a sufficient quantity of it, and of sufficient precision in it. As with all hypogeaic ants, the topochemical sense clearly predominates, and some idea of its delicacy may be gained through the perception of apparent odor-change in young queens already mentioned. The instant rejection of all but a very limited class of foodstuffs vividly indicates the degree of development of the sense of taste. Touch, because of the rather general distribution of the nerve-hairs, is both general and rather delicate. The touch of the antenna of a passing ant upon a resting sister will usually arouse it at once, regardless of the portion of the body with which contact is made.

The sense of sight, though feebly developed, is clearly present, and repeated tests with Wratten filters have convinced the writer of the inability of the ants to perceive the red rays, but the precise wave-length which limits perception is difficult to discover, both because of its probable high variability from individual to individual, and because of the impossibility of deciding whether in a given case the impulses of the ant are completely expressed in visible fashion. Fear, familiarity or unfamiliarity with surroundings, temperature and individual temperament add their difficulties to detract from precision.

After a rather extended and careful series of experiments, the writer has thoroughly convinced himself of the ability of *croceum* to perceive certain sound wave-lengths within the human sound-spectrum. These remain to be further elaborated and still further safeguarded from the error due to incomplete isolation of mechanical vibration before they may be presented.